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THE DICHOTOMY OF NATURE

ONE of the oldest ways of construing the universe is to see it made up by pairs of opposites. Matter and motion, good and evil, art and science, structure and function, life and the non-living, are obvious couples of this sort; the list can be extended almost indefinitely without going far from common sense. If it is the custom of modern philosophy to make little of these dualities, let us remember that years of epistemological controversy, training the devotee to the very pink of specialization and sophistication, have doubtless atrophied the power of seeing the obvious or of appreciating the significant. Philosophers of the past, indeed, have noted them often enough. The Pythagoreans are said to have arranged the universe on such a pattern, and Heraclitus found in opposition the genesis of reality. Plato's fundamental dualism, and the Aristotelian act and potency, applied unwaveringly by the scholastics, continued the tradition. In the *coincidentia oppositorum* of Nicolaus Cusanus, the old tendency reappears, and in the first period of modern philosophy the duality of mind-body was the bone of contention. Unfortunately, the philosopher's attention was soon turned into the narrow channel of the problem of knowledge and the study of reality languished. But eventually Hegel, whose merit lay in his profoundly objective interest, brought philosophy back to the normal point of view by presenting a map of the universe built out of pairs in an ascending scale. Yet because he made certain mistakes in his classification, his successors have tended to view askance the twofold habit of nature which he dwelt upon; whereby they have lost a deal of empirical truth. At any rate, it seems clear that this trait of reality, so frequently noticed, so ubiquitous, so momentous in human concerns, is likely to possess high metaphysical significance. Let us then set forth a list of the pairs which we find in the universe, and examine their meaning and connections. We shall find that they display a striking unity of plan, and one which, I venture to think, furnishes the key to some old mysteries.

We begin with a few cautions. The categories that follow are to be taken as matrices rather than polished gems; thought may carve them into sharp-edged concepts, yet in reality a category is (to vary the figure) a bright spot with luminous rays extending to other

bright spots, though not equally in all directions, and perhaps in some falling quite short. It need not be cut off clean from the rest, to be real for itself. Nor shall we proceed at once to the other extreme and declare that all categories are but abstractions from a continuous manifold. If they are in any sense abstract, it is nature and not man that does the abstracting; at least in many cases we shall find this to be so. And we use "category" here in a very general sense, to mean a habit of nature frequent enough to seem metaphysically important. We do not refuse, as Mr. Alexander does, to call *quality* a category. Technical accuracy, requisite indeed for some purposes, is not our present aim. One can point out a tree in the landscape, and discourse truthfully and significantly about it, without rule or compass; and perhaps the same is true, *mutatis mutandis,* of metaphysical discourse. And finally, it is perhaps well to say that we are not attempting to deduce the categories from some beginning; we do but expound a plan which nature seems to offer, and of which we are the passive spectators.

The first pair is that of things and relations between them. We place it first because this is the simplest, vaguest, and widest-spread of reality's characters. To the awakening consciousness, it may well have been the earliest datum, even though then meaning hardly more than vague shocks or bumps and the distinction of them. At any rate, many separate beings are presented—that is the first object upon which thought can exercise itself. But we are not now concerned with genetic order; rather with the objective and primarily the material world. Early man was doubtless more aware of such a datum at night; for at night he had opportunity to contemplate, and he saw the manifold of lights arranged in the heavens. But by day the same couple was offered to him by impinging objects, by the resistance or non-resistance of the environment. Nor have we of to-day been able to do without these categories, though reflection has taught us to call them, in the conceptual domain, term and relation, and in the physical universe, real substantial things or material objects and their arrangements. For the category of substance is embedded in this category of real things; objects in the external world come to us as real in and for themselves, present actualities with a subsistence of their own here and now, no matter what may appear at some later time. We may have to revise our interpretation of them, but the revision must be fair to the present appearance; this appearance has a natural right, as every man has a natural right to live. It may turn out to be illusory—so we later learn—but illusions have objective grounds. There is something out there; there are many somethings, indeed, and they are in some sort of order. They have a

solidity and a fastness which we designate by the word *substance.* Substance connotes that self-sufficiency and stability which is the essence of being. Man's primary discovery is that there are substances or beings and that they have relations. These two are the fixed hooks on which all subsequent information is hung; metaphysics starts from them and returns to them.

Of this primitive and ultimate pair, the first was more emphasized in olden time, while the second is having its turn to-day, and somewhat to the exclusion of its mate. The turn came to self-consciousness in E. Cassirer's *Substanz-theorie und Funktions-theorie;* but that side of the wheel has been long in view. Modern philosophy began with the two Cartesian substances, but matter at once evaporated into space, and mind was hardly more than thoughts. With Spinoza, substance retired into the infinite distance; in Leibniz, it was replaced by force. If Locke still dallied with common sense, Hume offended it beyond possible reconciliation by his reduction of matter to its effect upon mind, and of mind to a series of ideas. For some centuries now, mathematics has been the philosophic ideal, and mathematics knows no substance. To-day, the mathematical approach to the philosophy of nature has usurped the place of favor, and none may enter the field who can not say much in symbolic form. But even among the non-mathematical, is not the relational bias evident? The pragmatic tendency is to define things by their consequences, to interpret all by the context, to deny self-sufficiency everywhere. The Bergsonian system views the temporal relation as the very stuff of life. The speculative idealist finds the pathway to reality in the interdependence of all things, rather than in the things themselves; finite personality, soul-substance, and material stuff live only in their mutual connections and relations. And is it not the relations between men, rather than the individual man, that command our attention in what is called the "social problem"? We no longer think of the individual as a character existing in and for himself, but as one having his whole being in the relations he bears towards his fellows. Our modern philosophy and our modern way of thought, whether monism, or pragmatism, or intuitionism, is always relationism.

But a relation without terms is meaningless; and a philosophy which has forgotten the category of substance can not, in the end, give an intelligent account of reality. However refined its analyses, however imposing its array of proofs and its logical technique, it becomes no more than a science of the possible, a formalism dissociated from the real world. In spite of our respect for their logical attainments, it is hard for us to repress the feeling that the work

of Messrs. Russell, Whitehead, Broad and Alexander commits the old fallacy of deriving the individual from the universal, real things from their connections, matter from the union of space and time, terms from their relations. We suspect that under these leaders philosophy is in danger of becoming a sophisticated cult, and that we must go about on the other tack, paying respect to the empirical deliverances of science, to the kinds of substance it shows us, to the structure of the atom, the constitution of the cell, and the order of the sidereal system. For science deals first and last with real and separate things, with electrons which have permanent volumes, and mechanical masses that resist impact. If some of these were destroyed, presumably the others would remain; even though their behavior might be altered, their reality would be undiminished, and thereby their substantiality vindicated. Philosophy, after all, can not afford to cut itself quite loose from common sense. Common sense is not a sufficient condition of philosophy, but it is a necessary one. The statesman, however far-seeing his vision, can not well neglect public opinion, though public opinion is far from being a sufficient guide; and philosophy, likewise, must defer to the common belief in substances. Herein we have something to learn from the scholastics, who were able to combine extreme nicety of definition with regard for the categories of the practical man—these being the categories of common sense. We must frankly acknowledge that not even the most impressive massing of scientific technicalities, or the most brilliant literary style, can make motion without things that move, or time without things that change, any less meaningless than they ever were. Indeed, the modern preference for relation over substance would hardly have become so influential, were it not for our dislike of anything hidden. We wish all reality to be laid out in the open, in this age of publicity; whereas a substance is full of potencies not yet revealed, and contains reserves and private property not sharable. But here, too, we take leave alike of common sense and of scientific practise, since we have to admit the hidden and latent in persons, and since science can not do without potential energy.

Substances and relations are themselves given as many. In fact, each of these two is found to contain a dichotomy; for each contains two chief divisions, and each of these again two, and so on. This description, we shall immediately try to show, holds of our world as now presented to us; but also it may be sound chronology. It seems not unlikely that the physical universe began thus. Scientists have pictured a vague nebula with lumps, hardening into bodies with empty space between them, and eventually providing the present manifold universe. Always, to be sure, there were substance and

relations, spatial and temporal, as well as some degree of differentiation in the nebulous mass. A quite undifferentiated unity we are not asked to accept. Being must, apparently, have started (if it ever did start) with something of the duality of thing and relation. But our present purpose is not chronological; we wish rather to set forth the present dichotomy of nature, without regard to its genesis. And we find it to be of the following Porphyroid character, which we first state roughly and then go on to examine in more detail. Relations comprise two sorts, space and time; space comprises qualities and quantities. Out of the material thus provided we discover by analysis, identity and diversity, individual and class, ordinal and cardinal number, intensive and extensive quantity, velocity and mass, and endless derivatives of these; and in another aspect, act and potency, cause and chance. These categories make up the main tale of the formal side of the world. They constitute the subject-matter (not, properly speaking, the object-matter) of science. The object-matter, which our modern philosophy has all but overlooked, is found in the dichotomy of the other initial category, thing or substance. Things are found to comprise two sorts, living and non-living. The latter group contains mechanical and electrical phenomena, and electrical phenomena are of two kinds, positive and negative. Living beings, taken *en masse,* are either plant or animal; plants are divided into two great lines, the green plants and the bacteria, while animal evolution culminates in the two main divisions of arthropod and vertebrate. In the former division, as Bergson and others have pointed out, instinct is the chief guide of behavior; in the latter, intelligence. Herewith we are introduced to the fundamental cleavage of mind and body, and a long chain of couples in the region of mind—fact and value, theory and practise, art and science, and so on. On the other hand, if we consider the individual living being, we find the primary distinction within the cell, of nucleus and cytoplasm; reproduction by the process of bipartition; and early in the history of the metazoa and metaphyta, the distinction of sex—a distinction which in the highest vertebrate has become so significant as to color almost the whole of his life. Let this statement, rough as it is, and even inaccurate in certain details, suffice as an indication of our plan.

Now, of course, the universe may be classified from many points of view; and superficially one way may seem as good as another. Yet on the whole, the dichotomic plan can hardly be called arbitrary. The distinctions are in many, if not all, cases easy and objective; they are also fundamental, and have been reached or confirmed by centuries of scientific inquiry. Some there are who declare that the

scheme is anthropomorphic, due perhaps to the unsuspected influence of man's bilateral symmetry, or even his interest in sex; but it is not likely that the distinction between positive and negative electricity, or between time and space, or animals and plants, or nucleus and cytoplasm, has such an origin. Nothing is more objective than these; they are clearly distinct and they clearly belong together. It may be that the couples in the field of mind—art and science, value and fact, good and bad, *etc.*—have a subjective source in man's bilateral symmetry; even so, this symmetry is a physical fact, common to vast numbers of organisms and deserving a place with other fundamental dualities. We propose, then, to follow the clew, studying in turn the couples above named, and their logical relations in structure and function.

And first, how are substance and relation related? In three ways: they are complementary, *i.e.*, they hang together in a certain way, they are opposites, and they form an asymmetrical pair.

Substance means a solid real thing which impresses us; of the senses, it is most clearly given to touch. Touch is, of all our experiences, the special witness of reality, as when we test an hallucination by prodding it. The scientist, treating inertia as matter's fundamental attribute, takes his cue from touch, since touch is the sense of resistance, which is all that inertia means. But form and arrangement, while real enough, are more subject to illusion and less authoritative in their own right. Eye and ear, the organs devoted to these categories, are not the last court of appeal like touch, and correspondingly, substance has more of reality about it than relation. Substance is in this manner prior to form. If neither has much meaning without the other, that fact is not true of each in the same sense or degree. While we know no substance, perhaps, that is not in a manifold, such a thing is conceivable. We may imagine one bright star in a dark space as the sole content of the visual field; a term with almost no relation, or with relation only of distinction from the nothingness about it. But we can hardly conceive a relation without terms: that, indeed, seems, as noted above, a true case of what idealists call a vicious abstraction. If, then, relation and terms hang together, the latter do more of the supporting; and the mistake of idealists has been to be so prepossessed with the connection of these as to overlook their difference. The relation between them is not the same in its two directions; they are an asymmetrical couple. And we might have seen this by analysis, also. Relation is but carrying away from the present real thing to another, and you can not carry without a burden; which burden here is being. But thing or substance is, as immediate experience, to a degree self-contained, and

needs nothing to support it. Thus, relations need terms, and imply them, while a term makes relation possible but does not absolutely imply it. We may add that the notion of a relationless term has hovered over the philosophic arena ever since Parmenides; notably in the Thomistic God and the idealistic Absolute, to say nothing in detail of the mystics.

But the two prime categories are also opposites. Relation, in the most general meaning, is opposed to thing, because it carries us away to another, as motion is the opposite of rest. But it is not opposed in the contradictory way; this transition is not a denial but an ignoring. It is like attention, which, selecting one and rejecting another, negates without denying that other; there is no contradiction in the process. Indeed, to negate one thing without denying it, *is* to present another. Otherness is the original of negation, while contradiction is negation perverted and sinful. And so relation is that sort of negation which does not transgress the law of contradiction. If a substantial thing is position without contradiction, relation is opposition without contradiction.

Thus far, then, we have substance and relation, and the connection between them, which is that (1) they hang together in a rather free way, (2) one is prior to the other, and (3) they are non-contradictory opposites.

The second member, relation, is a very vague affair. As man becomes acquainted with his external world, two kinds of relation disengage themselves; relations of co-existence and sequence. These are given to sense, though not to the same sense. Space is given chiefly to vision, as substance to touch, and time preëminently to hearing. For vision is not directly, though it is indirectly, of bodies or resisting things; touch has spatial qualities, as bodies are in space, but vision is concerned primarily with extended things. Touch is also, in a way, intenser than vision, as substance is more real than relation. Vision, even of the most violent sort, as of the sun, does not shock the organism to the degree of the gentlest blow. It is impossible to see objects without seeing them extended or seeing some distance between them. And though we see processes and thereby time, we may also see a still panorama, which, for a few seconds at least, gives to vision no inkling of temporal quality. Hearing, however, is never without that quality; as it gives no spread-out content which so absorbs attention as to exclude the awareness of change. There is more discreteness in hearing than in vision, and discreteness, as we shall see, is a peculiarity of time. We are here talking of objective space and time which science uses, mathematics analyzes, and man more or less perfectly apprehends in vision and

hearing. We neglect the distinctions between conceptual, perceptual, visual and tactual space, and between perceived, remembered and scientific time.

Space and time hang together. Most of the real things in our material world are in motion; substances occupy space and change their occupation in time. So we are accustomed to say that each category involves the other. But if no more be said, the account is misleading. They involve each other in different ways, and the implication is not always binding in the same degree. Time might occur in a single substance—as if a star, with no fellows, might go through a change of color. Space is here involved, yet not in the sense of a positive condition with properties of its own—positions, distances, *etc.* Various real things must be given to afford such space; and time alone, of itself, does not imply such variety of coexistence. Time no more involves coexistence than one real thing involves others. Thereby time is more like its father, substance, whereas space will be seen more to resemble its mother, relation. There is a certain possibility of independence about time; though this is not actual, for really the world is a manifold. That being so, we find the two interwoven. Yet there is a difference; time is nothing without events or change, as a relation is nothing without terms; and therefore there is no empty time. Time is relative to events, or contents, and must, in the end, be estimated by the number of events that occur. Eventless or empty time is a paradox, and time therefore actually is interpenetrated by things; whereas empty space, or space without time, seems not so absurd. There may be empty volumes; there may be no ether. In fact, if there is no ether, probably *most* of space *is* empty; the distances between atoms are far greater than the extent of each atom, and there may be places through which electrons never actually pass. There may also be, beyond the Milky Way, an infinite volume of empty space in every direction. But is not empty space then a relation without terms? Rather it is the nearest approach we find in nature, to a relation without terms. It is not quite without its *relata,* but these *relata* are not in the first instance things, but positions. Now a position is not definable without reference to a body; it is given to sense as occupied by a body, and to thought as capable of occupation even when not occupied. So space, which is made of positions, is relative to body, though not always to actual bodies. But it is relative in a peculiar way, which shows us that even relations may have a semi-substantial character. Spatial relations are presented directly; we see the stretch between two bodies and the area of a body; we even see pure positions without magnitude. Relations are as much data as

things or qualities; and so are points. In the matter of points we have been enslaved by mathematism, which declares them to be the result of analysis, the limit of a series. But we should never get the notion of that limit from the series itself, as it is beyond the series; all limits are independent of their series and must be given directly and independently, to be known. Points, however, are given to experience when we see a *minimum visibile* which *appears* to have no extension. That the physical object thus seen turns out to be fairly large does not alter the character of our sight of the object. We know just how a true point would look if we could see it, as we know by a photograph just how a certain man would look if we could see him. A point is not merely a conceptual limit but a sense-datum, though revealed to us in an illusion. The same is true of a straight line. We see what looks like a line and straight, and were it not for that datum we should never frame the notion of a line as the limit of a narrowing plane. All these spatial entities are given in one way or another, though given as potencies or capacities, while yet real. Space could not wholly break away from matter or things, but it comes just as near as it can to that condition; empty space is the image of presented nothingness; the way nothingness would look if we could see it. Thereby, it is wrong to derive the concept of nothing from not-this, not-that, and so on to the limit; for we could have no notion of the limit were it not in some fashion given to sense. Yet even here space is relative, though only in the last analysis; relative to bodies, by which it is the capacity of being occupied. And this capacity means that something may move in—which in turn involves time. Thus it is impossible to describe space without at least eventual reference to time, whereas time may be described without reference to space though in fact the two are mingled. Time and space are tied together, but not glued together; and the cord is very elastic, for space can recede to an indefinite remove from time. Moreover, though the cord is made fast to the inwards of space, it is affixed to time only on the surface. Space implies time more than time implies space, while also space can roam free to an almost unbounded extent.

When philosophers declare that space and time are thoroughly interpenetrated, they seem to be unduly swayed by the modern love of connectedness, and the correlative hatred of the dissociated and solitary.

It has scarcely been recognized that time is the opposite of space; opposite as motion and rest are opposite. Time means change, which is both destruction and creation; space can not be destroyed, nor can new space arise, however far space be penetrated by time. Time can not be empty; space can be and as regards gross matter must be,

to allow motion. Space thus, by its negativity, makes room for time, which is full, to pass. Time also is impossible without differentiation, being succession of events, of which the present *exceeds* the others in actuality; space, being a potency, and by itself, empty, is everywhere the same, and as homogeneous as pure nothingness. Even if we supposed that space grew smaller as we receded from a given spot, that would be rather a body growing smaller; for if space were smaller, we need only draw upon the surroundings to make it larger. If a straight line be supposed to have curvature, we need only swerve from that line in a direction opposite that of the curvature, to find the true straight line. Homogeneity is no postulate or convention, but a deliverance of experience, or a consequence thereof; for whatever variations are displayed may be compensated from the surrounding void. Again, time is a device for securing a manifold without many things; an accomplishment which space can not compass. Space on the other hand makes up for the destructive affect of time by its power of coexistence; thereby something permanent persists along with, or underneath, the series of changes, and the integrity of substance is preserved through change. Time is irreversible and space is symmetrical; which explains why we experience only a little jot of time, the small specious present, while we can see nearly one half of infinite space. Moreover, to take for granted some of the later categories, we can see a whole series of complementary terms connected with these two respectively. In time, history is alone possible, with its progress or retrogression; also purpose and causation, which are the roots of value, responsibility and other categories of personality. Space, on the other hand, gives us the type of a fixed, ordered universe, such as rationalists and systematists love. It is the inspiration of the pantheist Spinoza, who wrote *ordine geometrico*, and of absolute idealism, which depreciates time. The latter is the guide of monadists or personalists; of a practical philosophy like Thomism, whose central category is causation. In fact the whole cleavage of theory and practise, of structure and function, of equality and privilege—the great body of human dualisms, takes its origin from this objective source. But for the present we do not show this in detail; we concentrate attention on a distinction which is fundamental for later insights, *viz.*, that space is quantitative and time is not. More exactly, space has but a minimum which is non-quantitative—the point—while time has but a minimum that is so—the little specious present; and even this varies irresponsibly.

The reason why time is not a quantity is that it is not a whole, for the parts drop out; as Baron Munchausen's horse, whose rear was cut away, could not be filled. Scientists often speak as if they

measured time, but they do not do so at all; and Professor Bergson is, we think, quite right in saying that science, and philosophy too, have too much cast reality into the mould of space. Science really does nothing but note coincidences between different events, and predict further coincidences. Whether all clocks and other material processes go faster in one day and slower the next, or as is generally supposed, at a uniform rate in both, is quite indifferent; all that calculation and prediction require is that the processes keep step. If the clock's hand goes around $24 \times 365\frac{1}{4}$ times every time the earth goes around the sun, that is enough for science. If the clocks, accurately made, keep time with one another, so that each angular position of the hands in one corresponds to the same in another, no more is needed. Science aims only to predict that when the hands are in a certain position, a certain event will occur. When a pendulum swings back and forth there is neither inequality nor equality of the intervals. If they feel equal or unequal, that is perhaps because we unconsciously estimate them in terms of bodily rhythms. The length of these we do not know, nor have we any test of their uniformity. The feeling of equality or inequality may, in fact, be as illusory as the feeling that we directly see a distance. Mr. Broad, who accepts time-quantity, argues that "it is very unlikely that the rotation of the earth, the swings of a pendulum, and the vibrations of an electron are all retarded according to the same law."[1] But we do not need to suppose these processes retarded alike, or hastened alike, or uniform. We simply want the events in them to correspond point for point. Difference of velocity means different amount of displacement in two bodies whose motion begins and ceases simultaneously. The displacement may be actual or potential. If body *A* has at one instant a tendency to greater displacement than body *B* at one instant, *A* has the greater velocity. Thus velocity may be defined without presumption of time-quantity. Time deals with events, not quantities; events ordered in a series where each has a definite position before, or after, or with, some other. Thus order does not imply quantity, though it may correspond to quantity; while quantity no doubt does imply order of less and greater, even as space implies time. To be sure, we say truthfully that a day is longer than one of its hours. Yet that could not be, unless a day signified that the earth had gone through more space by the 24th than by the end of the first hour. We define day and hour by reference to quantity of displacement, and then of course they seem quantitative. But in a non-spatial world, where a substance went through a series of changes, the only mean-

[1] *Perception, Physics, and Reality*, p. 318.

ing we could assign to time would be the number of changes it had suffered. In a wholly mental world, for instance, if a substance should go through a series of changes and then return identical to its original state, time would so far retreat on its own tracks and the past would be revoked.

In space, however, there is true quantity, because there are wholes whose parts stay to fill them up. Nor does the equality of two lengths depend upon the motion of a measuring-rod, superposed on each in turn and postulated as invariant. To compare the lengths of two straight lines A and B, we describe a sphere with A as radius, select the position A' of that radius which is parallel to B, and construct a parallelogram whose opposite sides are A' and B, and whose base is the line joining the corresponding ends of A' and B. If then the upper side starting from the other end of A' cuts line B exactly at its other end, B is equal to A; otherwise it is unequal to A. Obviously it is the simultaneous presence of the entities concerned which renders the test possible. But in time the backward end of our line always drops out. If we are to represent time by a line, it will not be by a straight line, which has a fixed length. The line will have any curvature we wish; it may even curve back into its beginning.

Until recently it was believed that all the processes of nature do keep step. So the defender of time-length says "whilst it is perfectly possible that a series which seems isochronous and fulfills the conditions with respect to another apparently isochronous series might not obey them when tested with respect to another apparently isochronous series, yet, as a matter of fact, this does not generally happen."[2] The reason all the processes or series seem to vary together is, no doubt, that they are of about the same order of magnitude. When we come to compare very high velocities with them, we find that the two orders do not keep step. The speed of light does not, like other speeds we are conversant with, increase as we move toward, or decrease as we move away from, the light-source. Now if uniform velocity meant equal space in equal times, then our time would have to shorten itself, or our space to enlarge itself, to account for the discrepancy; but both of these are really absurd. If, however, time has no fixed quantity, there is no reason why a series of changes like the light-waves should always give the same number for the same number of swings of the clock's pendulum. Keeping step between pendulums and light-waves is a phenomenon which can not be predicted or expected *a priori*. There is nothing paradoxical in its absence. The only paradox lies in the

[2] C. D. Broad, *Perception, Physics and Reality*, p. 321.

interpretation; in time being itself altered, or space changed in amount. Indeed, these conceptions refute themselves; for if time is hurried or delayed, there is a standard time by comparison with which the change is to be detected, and this standard is itself unaltered. And the same holds, *mutatis mutandis,* of space. But while we have very good empirical reasons for predicating quantity and uniformity of space, we have no such reasons for doing the same by time. So much on the topic of the opposition between space and time.

If substance is more real than relation, time is in the same way more real than space. Time lives by emphasis; we note its passage by rhythms, which impress our attention, whereas contemplation of the uniformity of space tends to sleep, as when we gaze into the crystal. So beauty of sound, or music which is given to hearing the temporal sense moves us far more than beauty of sight, as of color or form. But if time is stronger than space, space is bigger than time. Not only has space three ways of extending, but it lies there a vast empty potency, offering equal opportunity to all material possibilities, and exercising no restrictive force. Time does not actually lie out before us, for the future is not an empty receptacle, but is largely predetermined by past and present. Later we shall see that space is the source of chance, as is time of causation; at present it is enough to say that they are related somewhat as act and potency. In consequence of their asymmetry, they do not look opposite. For time is, to our spatialized mode of thought, easily symbolized by a line, and a line does not appear complementary to a volume. But time is not a line, in which the elements coexist. Extensive quantity does not characterize it; rather we must say that time is intensive. If the present is big with the future, the bigness is a density; while space is big, not with any precise future, but with all futures, as well as present and past—in short, space is big irrespective of its particular contents, big with its own bigness. And in fact, all the comparisons we have made between time and space show the asymmetry of their relationship; none more so indeed, than the most obvious difference of all, that time itself is asymmetrical while space is perfectly balanced in all directions.

We proceed to the next pair of categories. As relation was found to comprise space and time, so space is found to contain two sorts of entity, *viz.,* qualities and quantities. Quantities are directly sensed in the very perception of space; qualities, while equally sensed, are given in connection with things or substances. The empty separation or stretch between two stars has quantity; the

positions of the stars themselves are revealed by qualitative distinction of light from darkness. If positions are compared with lengths, the qualitative terms of space, those terms are marked out by being occupied; and it is the qualities of things that occupy them. Quantities are more akin to pure space, while qualities inherit more the traits of their grandfather, substance, and their father, time. Qualities might, indeed, be found in a spaceless time-world, in the form of nodes in the fortunes of a single substance; even in a pure space-world, they show their kinship with substance by inhering in the diverse substances which people that world. They are unique and simple, with the uniqueness of the present moment; they change, as positions by themselves can not do, either by movement or by gradation of degree. They are, like substance, self-contained, leaving no intrinsic reference to anything else; as a blue spot in the darkness contains no reference to red or other color, and is only blueness. But a quantity is intrinsically all quantities, as it is continuous and infinitely divisible; likewise it is relative to external quantities, being limited by them. Quantity is continuous because it is derived from space, which is in all ways homogeneous. Qualities on the other hand are discrete, no matter how finely graded be the transition from one to another. In a band of color passing from pure red through purple to pure blue, there is a definite point where blue enters and another where red departs. But a geometric line has no such points marked off, unless cut by another line of different *direction;* and directions, like positions, imply quality.

From the above it is easy to see that quality and quantity form a connected and asymmetrical couple of opposites. They are connected in that particular quantities are marked out by their color or brightness, which are visual qualities. Thus quantities of themselves imply the presence of some quality. But quality is not so intimately bound with quantity, just as substance, we saw, is not so intimately bound with relation, or time with space. Time could occur in a single thing, and so could quality. Most qualities, however, are quantitative, having degree or intensity; this is due to quantitative properties of moving particles, such as velocity of oscillation. Yet this phenomenon does not seem essential to the very being of a quality; all colors might have but one degree of brightness or saturation, all sounds the same loudness, without ceasing to be perceptible or significant. Quantities, however, contain just that implication and necessary connection which qualities lack; they continue the tradition of the category of relation, as qualities continue that of substance. Quantity is the region, there-

fore, of calculation, of discovery of something new from the already given, by implication; quality is a resting-point for the inquiring mind. From the point of view of one quality in space, it is chance what the others will be. Thus in the space-world, each of these categories affirms what the other omits. And their asymmetry is seen also in this same matter of implication. Quantity is a fecund attribute, an abstract relational affair rich in potentialities for thought because poor in individuation. Quality has more of actuality, quantity more of potency in the scheme of the material world.

Before tracing out further the categorical pattern, we must notice that we have now before us something like a completed first stage, or cycle. The third pair of categories is a union of the first two pairs, and thus closes the circle. Real things or substances in time and without space to move in, *must* possess quality; there is no other way in which change could be accomplished in them. Quality thereby enables substances to change; it is the link which unites them with time. On the other hand, relations between things in space, where there is no time and no motion, are fixed distances, and distance is a quantity. A quantity is thus a relation assuming the objective form of space; extensive in the first instance, and intensive when applied to a momentary quality. Our first six categories then complete a circle; but as the range of information to be acquired in this six-fold universe is far wider than in the original two-fold world, we had better use the spiral as our figure. The spiral is an open circle, wherein we ever return to the original reality with a greater breadth of knowledge. And at the same time we have unwittingly added a seventh category to our list, which has no mate; to wit, the category of the whole, the synthesis, the identity through difference of the material already presented. But we would emphasize the objectivity of the process; none of the categories, not even the seventh, are devised by man. They are discovered; man's activity is only that of directing his attention. Nor are the later categories deduced from the earlier; they are found branching from them in the epigenetic, not the preformative way.

That a natural cycle is here finished, is confirmed when we reflect that all the categories used by the sciences of external nature have now been provided, either explicitly or implicitly. To give an example or two: the atomic theory is but the scheme of the heavenly bodies in space, transformed to suit the needs of microcosmic explanation. Like the stars, the ultimate atoms are single or in clusters, drifting, streaming, revolving; the greatest difference

being in the extreme rapidity of atomic movements on the whole, as compared with those of the sidereal system. Again, the elementary quantities of physical science are said to be length, mass and time. If one account is correct there are really two, length and mass. Of these, length is already delivered, while mass is but quantity of matter, that is, of inertia. The prejudice against "quantity of matter" may be dismissed along with the dislike of substance. If matter is everywhere of uniform density, then mass is correlated with volume and is an extensive quantity. If density differs from atom to atom of equal volume, then mass is an intensive quantity.

We shall not here trace in detail the discovery of further categories; we confine ourselves to indication of the method of that discovery. Man has two faculties used for the purpose, sense and thought. Indeed, these two are related perhaps as the members of each couple above are related; that does not now concern us. Thought scrutinizes the gifts of sense, which takes its material direct from nature—even as animals feed upon the stores of energy laid up in green plants, which draw their sustenance direct from the environment. In scrutinizing, thought finds a thousand-fold more than sense has mentioned, in the package it has conveyed. Thought works also in two ways, by analysis and by synthesis. In both alike its activity consists in the fixing of attention upon the given; but in the former the model of the substance-time-quality series is its guide, and in the latter the model of the relational categories. Analysis observes each category by itself, whether it be a category of the substantive side or one of the relational side. Synthesis observes the relations between categories, whether they be the categories of the one group or the other. Let it now suffice to say that by these two methods we derive the remaining concepts used in science, such as identity and diversity, unit and collection, individual and universal, permanence and change, discreteness and continuity, ordinal and cardinal number, and so on. There is, however, one pair whose nature can not be fully understood from the study of these formal categories alone. Causation and chance are categories of the real world—though modern philosophy, unlike ancient and mediæval, has a curious bias against chance—and they seem to form an exception to the statement we made, that we had provided all the logical instruments of scientific research. They serve indeed to remind us that our world is not a merely formal affair, but a substantial one also. Modern philosophy, indeed, formalistic as it is, does tend to deny causation as well as chance; that is, as we hope later to show, because it has lost the category of

substance. In order to understand causation and chance, we must betake ourselves to that side of nature's dichotomy which is revealed under the head of substances. We must study the different kinds of real things, and their relations to one another; the nature of the distinction between living and non-living, mind and body, animal and plant, green plant and bacterium, and so on.

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THE LENGTH OF HUMAN INFANCY IN EIGHTEENTH-CENTURY THOUGHT

IN a recent number of this JOURNAL[1] Professor W. R. Wells points out an historical anticipation of the late John Fiske's "theory regarding the meaning and value of the prolonged period of human infancy in comparison with the briefer infancy of lower animals." Fiske called attention to the fact that, in Professor Wells's words, "a long period of infancy is valuable, first in giving time for educative influences to work upon the plastic brain and in making possible thereby a higher development of the mind, and second, in making necessary a greater degree of parental coöperation than is the case among the lower animals"—thus resulting in "the development of the domestic virtues." These considerations seemed to Fiske at once to "bridge the gap between brute and man," to "account for the evolution of human intelligence and morals," and to aid in "justifying the ways of God to man." But, as Professor Wells notes, the same considerations had been dwelt upon—especially with the third of these purposes in view—by an anonymous writer in *The Friends' Annual* in 1834.

There is, however, nothing surprising or "striking" about this anticipation of Fiske; for precisely the same observations concerning the significance of the longer infancy of the human animal were among the familiar commonplaces of eighteenth-century thought. They were expressed both in the philosophical poem and in the political treatise most widely read in that century.

In his account of the beginning and early stages of human society, in the *Essay on Man* (1733), Pope wrote (Epistle III, 125 ff.):

> Thus bird and beast their common charge attend,
> The mothers nurse it and the sires defend;
> The young dismissed to wander earth or air,
> There stops the instinct and there ends the care. . . .
> A longer care man's helpless kind demands;

[1] Vol. XIX, p. 208.